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SUSQUEHANNA RIVER BASIN
KEHLEY RUN
SCHUYLKILL COUNTY
PENNSYLVANIA

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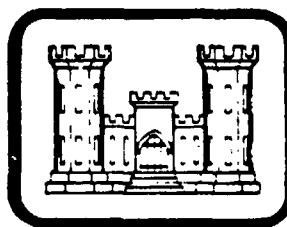
KEHLEY RUN DAM NO. 6

NDI ID NO. PA-01019
DER ID NO. 54-20

SHENANDOAH MUNICIPAL AUTHORITY

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PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM



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DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Prepared By:

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

JUNE 1981

402836

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

NDI ID No. PA-01019, DER ID No. 54-20

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam: Kehley Run Dam No. 6
NDI ID No. PA 01019
DER ID No. 54-20

Size: Small (20.1 feet high; 158 Acre - Feet)

Hazard Classification: High

Owner Shenandoah Municipal Authority
Shenandoah, Pa.

State Located: Pennsylvania

County Located: Schuylkill

Stream: Kehley Run

Date of Inspection: 3 December 1980 and 20 May 1981

The visual inspection and review of available design and construction data indicate that Kehley Run Dam No. 6 is in fair condition. The deteriorated condition of the left spillway and the partially blocked condition of the right spillway channel are the primary deficiencies which cause concern for the safety of this facility. Based on the recommended guidelines, the Spillway Design Flood (SDF) for this facility is in the range of 1/2 the Probable Maximum Flood (PMF) to Full PMF. Due to the high potential for loss of life in event of a failure of this dam, the full PMF was chosen as the recommended SDF.

The hydrologic and hydraulic computations indicate that the combination of reservoir storage and discharge capacity will not pass the SDF (Full PMF) prior to overtopping the embankment. Under present conditions, the discharge/storage capacity is 92% of the PMF prior to overtopping. In accordance with the criteria outlined and evaluated in Section 5.5 of this report, the discharge capacity for Kehley Run Dam No. 6 is considered to be inadequate.

Kehley Run Dam No.6.

The following recommendations should be implemented without delay.

a. The owner should retain a qualified professional engineer experienced in dam design and construction to develop plans for remedial work required for the spillway facilities. This should include the clearing of all obstructions from the right spillway channel.

The existing outlet works should be inspected and evaluated by the engineer as part of this study. An upstream closure should be provided for the outlet works. Any remedial measures recommended by the engineer at the conclusion of his investigations should be implemented without delay by the owner.

b. The trees and brush should be cleared from the embankment under the guidance of a qualified engineer.

c. The riprap failures on the upstream face should be repaired.

d. The two fourteen inch diameter cast iron pipes should be plugged.

e. A formal surveillance and downstream emergency warning system should be developed for use during periods of heavy or prolonged precipitation.

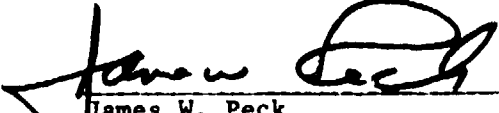
f. An operation and maintenance manual or plan should be prepared for use a guide in the operation and maintenance of the dam during normal and emergency conditions.

g. A schedule of regular inspection by a qualified engineer should be developed.

APPROVED BY:

DEPARTMENT OF THE ARMY

BALTIMORE DISTRICT, CORPS OF ENGINEERS


James W. Peck
Colonel, Corps of Engineer
Commander and District Engineer

DATE: 28 July 81

KEHLEY RUN DAM NO. 6



OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

KEHLEY RUN DAM NO. 6

NDI ID No. PA 01019

DER ID No. 54-20

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of non-federal dams throughout the United States.

b. Purpose. The purpose of this inspection is to determine if the dam constitutes a hazard to human life and property.

1.2 Description of Project.

a. Description of Dam and Appurtenances. Kehley Run Dam No. 6 is an earthfill structure approximately 20.1 feet high and 1400 feet in length including two spillways. There are spillways provided at both abutments. The left spillway control is a rectangular broad-crested weir approximately 11 feet in length, and the right spillway control is a trapezoidal shaped broad-crested weir approximately 26 feet in length. The outlet works is a 12 inch water supply pipe through the dam, with an approximate six foot square concrete intake structure located in the bottom of the reservoir.

Note: The U.S.G.S. 7.5 Minute Quadrangle Sheet (Shenandoah, Pa.) indicates a reservoir elevation of 1675.0, which is used as spillway crest elevation in this report.

b. Location: West Mahanoy Township, Schuylkill County, Pa.

U.S.G.S. Quadrangle - Shenandoah, Pa.

Latitude 40° 30.4'; Longitude 76° 12.0'

Refer to Plates I & II, App. E.

c. Size Classification: Small: Height-20.1 feet, Storage-158 acre feet.

d. Hazard Classification: High (Refer to Section 3.1.e)

e. Ownership: Shenandoah Municipal Authority
26 West Lloyd Street
Shenandoah, PA 17976
ATTN: Mr. Charles Dallasia, Manager

f. Purpose: Water Supply

g. Design and Construction History:

No information concerning the original design and construction of the dam is known to exist. Repairs to the left spillway and the addition of a formal spillway at the right end of the dam were apparently accomplished in the late 1940's.

h. Normal Operating Procedure:

No formal operating procedures exist. Inflow which exceeds the capacity of the outlet works will be stored until it overflows the spillways and flows into Kehley Run Dam No. 5 Reservoir located immediately downstream.

1.3 Pertinent Data.

a. Drainage Area (square miles)

From files:	0.35
Computed for this report:	0.30
Use:	0.30

b. Discharge at Damsite (cubic feet per second)

Maximum known flood	unknown
Outlet works with maximum pool (El.1677.5)	11
Spillway with maximum pool (El.1677.8)	450

c. Elevations (feet above mean sea level)

Top of Dam	
Design	unknown
Existing	1677.8
Normal pool	1675.0
Spillway Crest (Both spillways)	
Design	unknown
Existing	1675.0
Outlet Works	
Upstream invert	unknown
Downstream invert (estimated)	1658
Tailwater	1661.7
Streambed at toe (estimated)	1657.7

d. Reservoir Length (Feet)
 Normal pool (El.1675.0)
 Maximum pool (El.1677.8)

1500
 1700

e. Storage (acre-feet)

Normal pool (El.1675.0)
 Maximum pool (El.1677.8)

41
 158

f. Reservoir Surface (acres)

Normal pool (El.1675.0)
 Maximum pool (El.1677.8)

25.0
 37.5

g. Dam

Note: Refer to exhibits in Appendix A for profile and section

Type

Earthfill

Length

1400 feet including
 both spillways.

Top Width

33 feet

Height

20.1 feet

Side Slopes

Upstream
 Downstream

Varies 1V:0.6H to 1V:0.8H
 1V:0.8H

Zoning

None

Cutoff

None

h. Outlet Works.

Type

12 inch cast iron pipe

Closure

Valve d/s of toe

i. Spillways

Left Spillway

Type
 crested concrete weir

Rectangular Broad-

Location

Near left abutment of dam

Length

11 feet

<u>Crest Elevation</u>	1675.0 m.s.l.
<u>Freeboard</u>	2.8 feet
<u>Approach Channel</u>	Reservoir
<u>Downstream Channel</u>	Concrete lined channel; then rock lined
<u>Bridge</u>	Concrete
<u>Right Spillway</u>	
<u>Type</u>	Trapezoidal shaped broad- crested concrete weir
<u>Location</u>	Near right abutment dam
<u>Length</u>	26 feet
<u>Crest Elevation</u>	1675.0 m.s.l.
<u>Freeboard</u>	2.8 feet
<u>Approach Channel</u>	Reservoir
<u>Downstream Channel</u>	Rock paved for 300 feet then earth with trees and brush.

of

SECTION 2
ENGINEERING DATA

2.1 Design.

The available data for Kehley Run Dam No.6 consists of an inventory form and inspection reports provided by PennDER. Also available are a permit application report and correspondence concerning the spillway repairs which were apparently accomplished in the late 1940's.

2.2 Construction.

No information concerning construction of the dam is known to exist.

2.3 Operation.

No formal records of operation or maintenance exist.

2.4 Evaluation.

a. Availability. All available written information was contained in the files provided by PennDER.

b. Adequacy. The available data, including that collected during the recent detailed visual inspection, are considered to be adequate to make a reasonable assessment of the dam.

SECTION 3

VISUAL INSPECTION

3.1 Observations.

a. General. The overall appearance and general condition of the dam and appurtenances are fair. Noteworthy deficiencies are described briefly below. The visual inspection checklist, field sketch and profile are provided in Appendix A. Photographs taken during the inspection are provided in Appendix C.

At the time of the initial inspection, the reservoir pool was ten feet below spillway crest due to the extreme drought conditions. On 20 May 1981, a brief review inspection was made in order to determine if any significant changes in the structure had occurred since the initial inspection of 3 December 1980. The only significant change noted was additional deterioration of the left spillway.

b. Embankment. The embankment is constructed of earthfill and is roughly vee-shaped in plan. The 33 foot wide crest is traversed by a dirt road which is used for access to perform maintenance. As shown on Exhibit A-2, the crest is high in the center and lower toward the spillways. According to previous inspection reports, the dam was constructed this way. Small trees and brush have recently been cut on the crest and the upstream face; however, standing trees and brush cover the downstream face. The upstream slope varies from 1V:0.6H to 1V:0.8H. Hand-placed stone covers the entire face except for the upper 2.5 feet. Concrete has been placed on the stone for a width of approximately 200 feet at the center of the dam. There are numerous bulges in the rock facing, the cause of which is a combination of the steepness of the slope and frost action. A twenty-five foot wide section of this face failed in about 1920.

The downstream face slopes at 1V:0.8H with local areas at 1V:0.2H. The hand-placed stone on this face extends from the left abutment to a point 400 feet to the left of the right abutment. Portions of the stone paving that are adjacent to the downstream lake have slipped at least five feet below the crest. Two 14-inch diameter cast iron pipes exit the downstream toe of the embankment about 20 feet to the right of the left abutment spillway. These pipes are currently blocked with stones. The upstream ends could not be found.

c. Appurtenant Structures. Two spillways are provided at this facility, one at each abutment. The spillway at the left abutment consists of a rectangular broad-crested concrete weir and concrete lined discharge channel through the dam. A bridge passes over the discharge channel at the centerline of the dam. At the downstream toe this channel bends 90 degrees to the right and continues along the toe. The channel is lined with rock from the bend to the discharge end at the downstream reservoir. The surface of the weir is spalled. A vee-shaped notch, 3 inches deep, is cut into the center of this control section. The wing walls which extend along the upstream face of the dam are cracked and broken. The right wingwall is leaning and the top portion is lying in the reservoir. The left wall between the weir and the bridge is

lying in the discharge channel. This is allowing embankment material to slough into the channel. The right wall at this location is cracked through in several places and is displaced. A section adjacent to the bridge has collapsed into the channel. Downstream of the bridge the concrete is in fair condition.

The right spillway consists of a concrete weir and rock lined channel. The surface of the weir is deteriorating due to weathering. The hand-placed rock lining covers the bottom and side slopes of the channel for a distance of about 300 feet. The rock is in fair condition with a few scattered stones displaced. Three concrete cutoff walls or sills are spaced along the channel. Beginning approximately 100 feet downstream of the control section, the discharge channel is obstructed with trees and brush until ending at the downstream reservoir.

The outlet works consists of a 12 inch cast iron water supply pipe through the middle of the dam. The intake structure is an approximate six-foot square concrete box in the center of the reservoir. Due to the extremely low pool on the day of the initial inspection, the top one to two feet of this structure was visible in the middle of the lake. The discharge end of the pipe is located about 10 feet from the downstream toe. The pipe is protected by stones piled over it. The valve, which was not operated, is located on the end of the pipe. During normal conditions, the valve is submerged in the downstream reservoir.

d. Reservoir. The reservoir slopes are wooded and flat. Pennsylvania Route 924 crosses the upper end of the reservoir area. Fetter Pond, a strip mine pond with a natural outlet, is located approximately 2,500 feet upstream of the dam.

e. Downstream Channel. Immediately downstream is Kehley Run Dam No. 5, DER No. 54-19, a high hazard dam with an inadequate spillway. The reservoir pool of this lower dam submerges the downstream toe of Kehley Run Dam No. 6. The channel of Kehley Run below this dam is narrow and steep for one mile before becoming flat and entering the town of Shenandoah. Kehley Run Dam No. 4, DER No. 54-18, and Dam No. 3, DER No. 54-17, are 1,500 feet and 4,200 feet, respectively, downstream of Kehley Run Dam No. 6. Kehley Run Dam No. 3 is a high hazard dam with an inadequate spillway. Pennsylvania Route 924 crosses the channel approximately 2,200 feet downstream of the dam. Numerous homes are located in the floodplain of Kehley Run in the Town of Shenandoah. Failure of Kehley Run Dam No. 6 would cause overtopping and probable failure of the downstream dams. This failure would create the potential for the loss of more than a few lives and extensive property damage in the Town of Shenandoah. Failure of the downstream dams would also interrupt the town's water supply, resulting in a severe economic loss to the community. A high hazard classification is warranted for this dam.

f. Evaluation. Due to the drawn down condition of the reservoir, the upstream face could be observed in detail; however, any possible seepage problems would not be evident on the downstream face. The operational condition of the outlet works must be more fully determined. This should include regular maintenance of the valve and the development of a means for

positive upstream closure. The trees and brush on the downstream face should be removed. In addition, all riprap failures should be repaired. The poor condition of the left spillway causes concern for its safe operation during a flood event. The right spillway discharge channel must be cleared of all obstructions now and on a continuing basis.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure. The lake is normally maintained at the level of the spillway crests, elevation 1675.0. Normal flow through the dam is apparently maintained by an intake structure in the center of the lake. On the date of the initial inspection, the reservoir was low, showing signs of the recent drought conditions experienced in Northeast Pennsylvania. Flow in excess of the outlet pipe will be stored until reaching the level of the two spillway crests. Additional inflows would then be discharged through the two emergency spillways.

4.2 Maintenance of Dam. The condition of the dam and its appurtenances as observed by the inspection team was fair. The embankment has small tree growth and shrubs along the crest and downstream face. In addition, heavy tree growth exists in the right spillway discharge channel. The left spillway has deteriorated and portions of the concrete walls are collapsed and severely cracked. No formal maintenance manual exists.

4.3 Maintenance of Operating Facilities. The operational condition of the outlet works could not be determined. No formal operation manual exists.

4.4 Warning System. The owner of the dam has previously been requested by PennDER to develop a warning system for downstream residents in connection with other dams in the Kehley Run system inspected during 1980. This warning system should be developed to include all dams of the Kehley Run system. If this warning system has not been implemented, it is recommended that a formal warning system be developed.

4.5 Evaluation. Maintenance of the facility appears to be insufficient at this time. The outlet works line should be provided with a positive means of upstream closure. The deteriorated left spillway should be repaired. Trees and brush should be removed from the embankment and right spillway discharge channel. Formal manuals of operation and maintenance should be developed to ensure that all needed maintenance is identified and performed. In addition, a formal warning system for the protection of downstream inhabitants should be developed. Included in the plan should be provision for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

SECTION 5

HYDRAULIC/HYDROLOGIC EVALUATION

5.1 Design Data. No design reports or miscellaneous design data are known to exist for the facility. Spillway calculations dated 1945 were found in the PennDER files, and indicated that Reservoir No. 6 should have a spillway capacity of 1059 cfs. The capacity at the facility at that time was only 145 cfs, and was recommended to be increased to only 600 cfs.

5.2 Experience Data. Records of reservoir levels and/or spillway discharges are not available. No records of past performance are available.

5.3 Visual Observations. On the date of the inspection, one condition was present that would prevent the facility from operating safely during a flood event. The deteriorated left spillway walls should be repaired as they are partially obstructing flow. Although of lesser concern, the right spillway discharge channel should be cleared of trees and brush to prevent obstructions from hindering spillway flow. See Appendix C for photographs of the two spillways.

5.4 Method of Analysis. The facility has been analyzed in accordance with procedures and guidelines established by the U.S. Army Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. This analysis has been performed using a modified version of the HEC-1DB computer program developed by the U.S. Army Corps of Engineers, Hydrologic Engineering Center, Davis, California. Capabilities of the program are briefly outlined in the preface contained in Appendix D.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with the procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the SDF for Kehley Run No. 6 Dam ranges between the one-half Probable Maximum Flood (PMF) and the full PMF. This classification is based on the relative size of the dam (small) and the potential hazard of failure to downstream development (high). Due to the extensive downstream development in the town of Shenandoah, the selected SDF was the full PMF.

b. Results of the Analysis. Kehley Run Dam No. 6 was evaluated under near normal operating conditions. The starting lake elevation was set at spillway crest, elevation 1675.0. For this study the water supply line was neglected (assumed blocked). The dam currently has a freeboard of 2.8 feet and a combined spillway width of 37 feet. Inflow hydrographs and spillway capacity at top of dam were calculated. Results are as follows:

Spillway Capacity at top of dam	450 cfs
SDF (full PMF) peak inflow	770 cfs

The overtopping analysis (found in Appendix D using the HEC-1DB computer program) indicates that the discharge/storage capacity of Kehley Run Dam No. 6 can pass 92% of the PMF prior to overtopping the embankment. Since the facility can pass more than 50% of the PMF, no breach analysis is required.

5.6 Spillway Adequacy. Under existing conditions, Kehley Run Dam No. 6 cannot accommodate the SDF (full PMF); therefore, the spillway is rated as inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

(1) Embankment. Kehley Run Dam No. 6 is a vee shaped earthfill embankment constructed of silty, gravelly sand. It is a tree and brush covered structure that is in fair condition. The embankment has a 33 foot wide crest but has steep side slopes. The downstream slopes are 0.8H:1V with some areas as steep as 0.5H:1V, and upstream slopes vary from 0.8H:1V to 0.6H:1V. Dry laid stones protect and support the slopes. The embankment is considered stable; however, it is obvious that the slopes have a factor of safety very near one since numerous signs of minor sloughing are evident. The upstream riprap has numerous bulges, but the embankment appears stable. A 20 foot long crack was observed along the upstream crest, which indicates that the minor sloughing of the slope is continuing to occur.

About 200 feet of concrete patching on the upstream slope indicates that repairs have been made. Stone protection on the downstream slope has slipped by as much as 5 feet in some areas just above Reservoir No. 5.

(2) Appurtenant Structures. Two spillways serve this facility. One is located in each abutment.

The spillways are in a deteriorated condition and require repairs. The left spillway is a concrete structure 11 feet wide that is bridged by a concrete slab to allow vehicle traffic access to the dam. The walls of this structure are broken and collapsed. After passing through the dam, the spillway makes a 90° right turn and discharges into a channel that parallels the embankment toe to Reservoir No. 5. No erosion of the embankment was observed. The right spillway is 26 feet wide. It has a concrete weir, but the channel and walls are of dry laid stone and extend approximately 300 feet downstream from the weir.

b. Design and Construction Data

(1) Embankment. None

(2) Appurtenant Structures. None

c. Operating Records

d. Post-Construction Changes. A permit application was submitted to PennDER in 1945 to repair the spillway and construct an additional spillway at the right end of the dam. Apparently, the repairs to the left spillway and construction of the right spillway were both completed based on observations during the inspection.

e. Seismic Stability. The dam is located in Seismic Zone 1. Based on visual observations, the dam is considered to be statically stable. Therefore, on the basis of the recommended criteria for evaluation of seismic stability of dams, the structure is presumed to present no hazard from earthquakes.

SECTION 7

ASSESSMENT AND RECOMMENDATIONS

7.1 Dam Assessment.

a. Safety. The visual inspection and review of available design and construction data indicate that Kehley Run Dam No. 6 is in fair condition. The deteriorated condition of the left spillway and the partially blocked condition of the right spillway channel are the primary deficiencies which cause concern for the safety of this facility. Based on the recommended guidelines, the Spillway Design Flood (SDF) for this facility is in the range of 1/2 the Probable Maximum Flood (PMF) to full PMF. Due to the high potential for loss of life in event of a failure of this dam, the full PMF was chosen as the recommended SDF.

The hydrologic and hydraulic computations indicate that the combination of reservoir storage and discharge capacity will not pass the SDF (Full PMF) prior to overtopping the embankment. Under present conditions, the discharge/storage capacity is 92% of the PMF prior to overtopping. In accordance with the criteria outlined and evaluated in Section 5.5, the discharge capacity for Kehley Run Dam No. 6 is considered to be inadequate.

b. Adequacy of Information. The data contained in PennDER files, in conjunction with data collected during the recent visual inspection, are considered to be adequate for making a reasonable assessment of this dam.

c. Urgency. The recommendations presented below should be implemented without delay.

d. Necessity for Additional Studies. The results of this inspection indicate a need for additional studies by a qualified professional engineer to determine remedial measures required for the spillway facilities for this dam.

7.2 Recommendations.

a. The owner should retain a qualified professional engineer experienced in dam design and construction to develop plans for remedial work required for the spillway facilities. This should include the clearing of all obstructions from the right spillway channel.

The existing outlet works should be inspected and evaluated by the engineer as part of this study. An upstream closure should be provided for the outlet works. Any remedial measures recommended by the engineer at the conclusion of his investigations should be implemented without delay by the owner.

b. The trees and brush should be cleared from the embankment under the guidance of a qualified engineer.

- c. The riprap failures on the upstream face should be repaired.
- d. The two fourteen inch diameter cast iron pipes should be plugged.
- e. A formal surveillance and downstream emergency warning system should be developed for use during periods of heavy or prolonged precipitation.
- f. An operation and maintenance manual or plan should be prepared for use as a guide in the operation and maintenance of the dam during normal and emergency conditions.
- g. A schedule of regular inspection by a qualified engineer should be developed.

APPENDIX A

CHECKLIST - VISUAL INSPECTION

Check List
Visual Inspection
Phase I

Name Dam Kehley Run #6 DER ID No. 54-20 County Schuylkill State Pennsylvania

Date(s) Inspection 3 Dec 80 Weather Clear, windy Temperature 30°
20 May 81

Pool Elevations at Time of Inspections 1665.5M.S.L. Tailwater at Time of Inspections 1661.7M.S.L.

Inspection Personnel:

J. Blanco, C.O.E.

E. Hecker, C.O.E.

B. Cortright, C.O.E.

J. Evans, C.O.E.

B. Cortright Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS
Noticeable Seepage	None
Junction of Embankment with: Abutments Spillway	Left spillway - Walls u/s of bridge collapsed; embankment slopes down to channel
Surface Cracks	None
Crest Alignment	Horizontal - Fair; V-shaped pointing downstream Vertical - High in center; low toward spillway and at abutments. Maximum variation between spillways 0.6 foot.
Unusual Movement or Cracking at or beyond the Toe	None. One-third of toe area covered by d/s reservoir

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS
Sloughing or Erosion: Embankment Crest/Slopes Abutment Slopes	Sloughing of crest due to collapse of left wall of left spillway. See riprap below.
Riprap	Hand-placed, dry laid stone on u/s & d/s slopes; numerous bulges on upstream slope. Concrete placed over stone for width of 200± feet at center of dam on u/s face. Downstream face rock slipped 5 feet adjacent to d/s reservoir.
Instrumentation	None
Staff Gage	None
Miscellaneous	Small trees and brush on downstream face. Recently cut brush and trees on crest and upper 2 1/2 feet of u/s face.

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS
Intake Structure	Approx. 6 foot x 6 foot concrete structure in middle of reservoir. Top 1-2 feet exposed (Res. pool 10 feet below spillway crest) No access
Outlet Conduits	Reported to be through center of dam. Both ends submerged.
Gates or Valves	Gate valve on end of pipe. Condition unknown.
Outlet Structure	None. Pipe covered w/stone in bottom of Reservoir #5
Outlet Channel	Reservoir No. 5

SPILLWAY

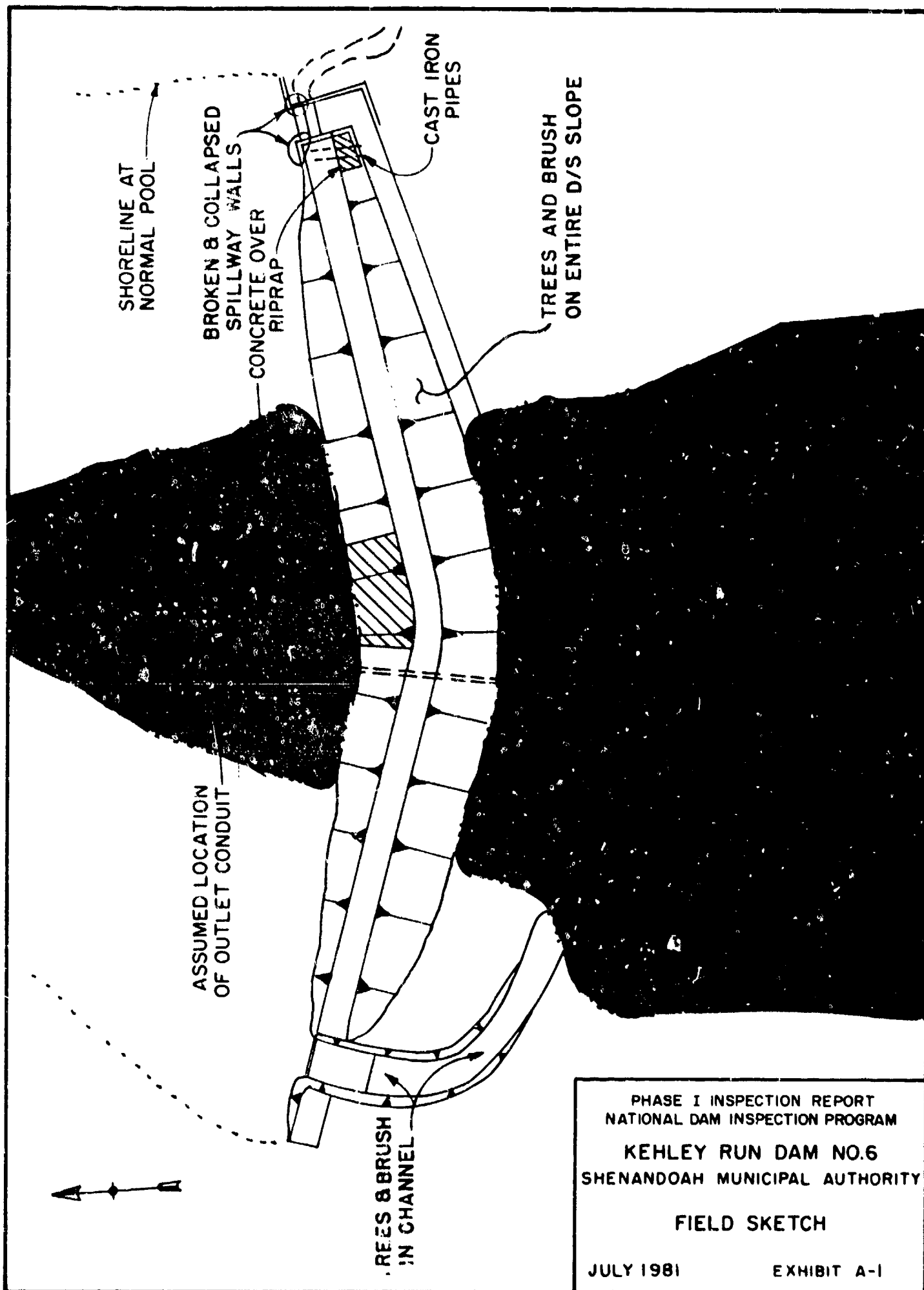
VISUAL EXAMINATION OF		OBSERVATIONS
Approach Channel		Reservoir - No obstructions to flow
Concrete Weir and Walls		<p>Left Spillway- Rectangular; concrete is spalled w/small notch. Right wingwall (parallel to u/s face) is broken off; top part collapsed into reservoir with remainder broken and leaning. Both walls adjacent to weir are leaning into spillway.</p> <p>Right Spillway- Concrete control section deteriorated (spalled surface). No walls</p>
Discharge Channel		<p>Left Spillway- Concrete lined through embankment Concrete bridge in fair condition at dam crest. Left wall u/s of bridge collapsed into spillway right wall broken in sections and leaning. Channel along toe in fair condition (rock lined)</p> <p>Right Spillway- Hand-placed rock in fair condition on bottom and sides for 300 feet. Trees and brush clog channel from 100 feet d/s weir to outlet (Res. No. 5)</p>

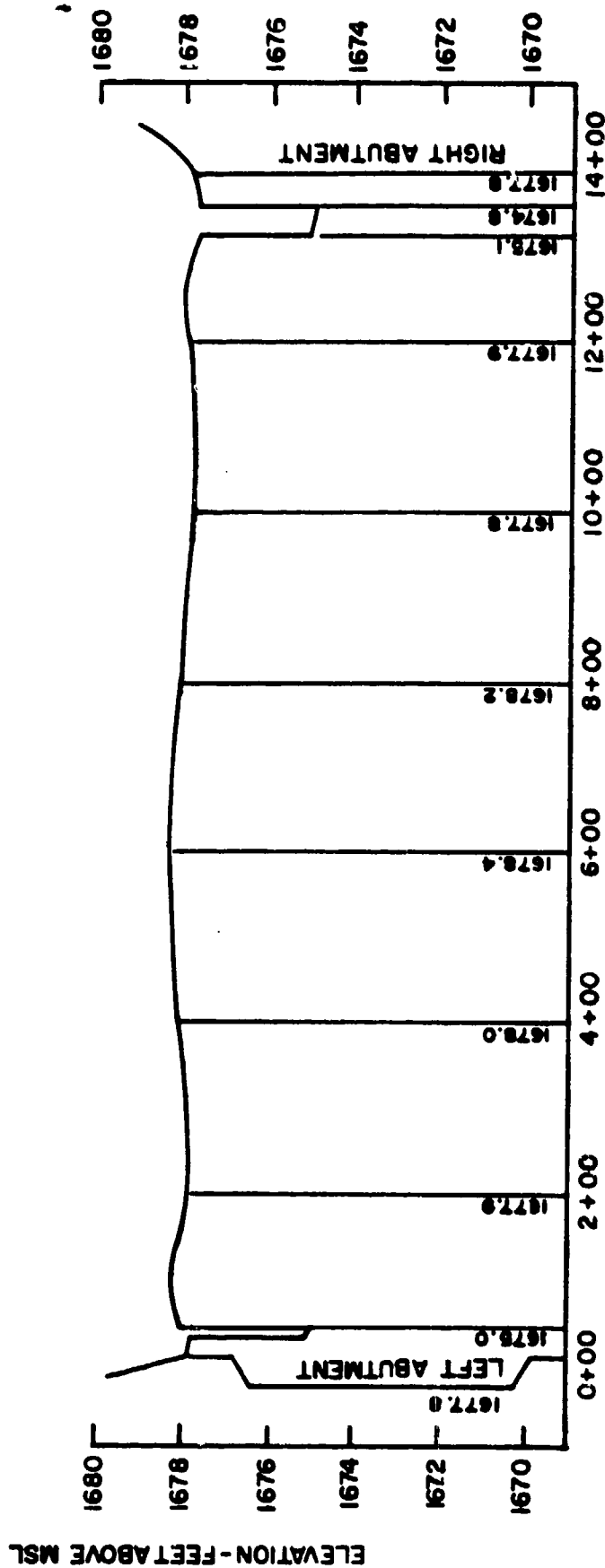
RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS
Slopes	Flat and wooded. No residential development
Sedimentation	None

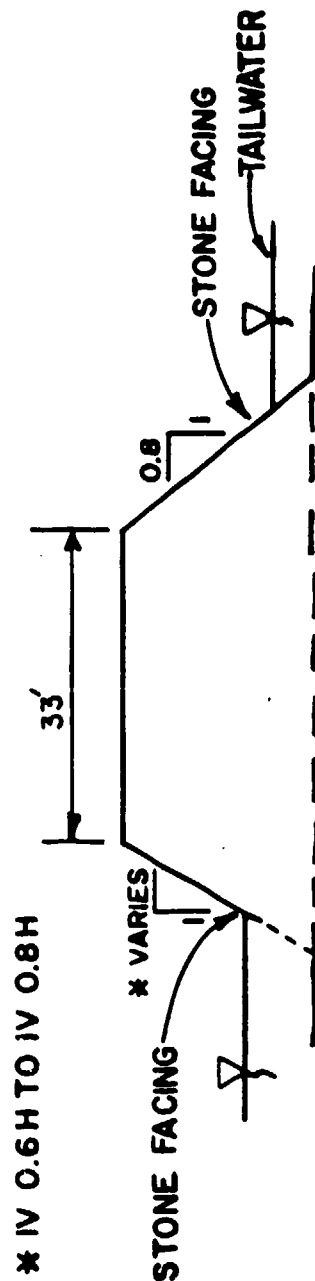
DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS
Condition: Obstructions, etc.	Kehley Run Dam #5 immediately d/s. Kehley Run narrow and confined with several additional reservoirs before widening out in borough of Shenandoah.
Slopes	Moderate to steep. Appear to be stable.
Approximate Number of Homes	Approximately 400 homes (Town of Shenandoah)





TOP OF DAM - PROFILE
 SCALE - HORIZ. 1 IN. = 200 FT.
 SCALE - VERT. 1 IN. = 4 FT.



SECTION
 SCALE 1 IN. = 20 FT.

PHASE I INSPECTION REPORT
 NATIONAL DAM INSPECTION PROGRAM

KEHLEY RUN DAM NO. 6
 SHENANDOAH MUNICIPAL AUTHORITY
 PROFILE & SECTION

JULY 1981

EXHIBIT A-2

APPENDIX B

CHECKLIST - ENGINEERING DATA

Check List
Design, Construction, Operation
Phase I

Name Dam Kehley Run #6 DER ID No. 70-54-20

ITEM	REMARKS
As-built Drawings	None
Regional Vicinity Map	U.S.G.S. Shenandoah, Pa., Quadranglesheet, 7 1/2 minute quad sheet. See Appendix E, plate E-II.
Construction History	No data available
Typical Sections of Dam	None
Outlets - Plan Details Constraints Discharge Ratings	No data. A 12 inch cast iron pipe regulates pool level below spillway crest. Discharges into Kehley Run Dam No. 5.
Rainfall/Reservoir Records	None

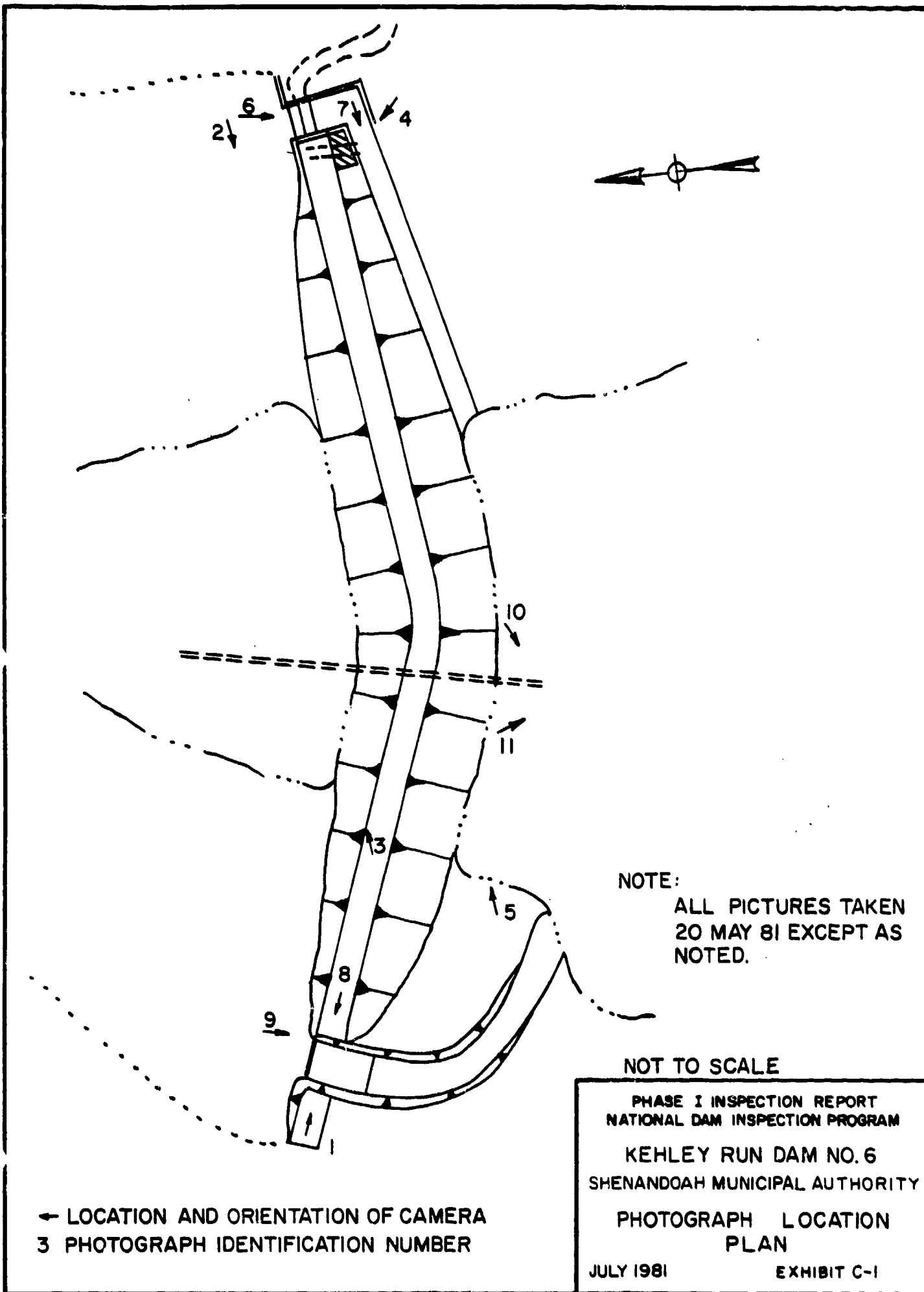
ITEM	REMARKS
Design Reports	None
Geology Reports	None
Design Computations Hydrology & Hydraulics Dam Stability Seepage Studies	None
Materials Investigations Boring Records Laboratory Field	None
Post-Construction Surveys of Dam	None
Borrow Sources	No Data

ITEM	REMARKS
Monitoring Systems	None
Modifications	Repairs to left spillway and addition of a formal spillway in right abutment built in late 1940's
High Pool Records	None
Post-Construction Engineering Studies and Reports	None
Prior Accidents of Failure of Dam Description Reports	N/A
Maintenance Operation Records	None

ITEM	REMARKS
Spillway Plan Sections Details	None
Operating Equipment Plans & Details	N/A
Specifications	No data
Miscellaneous	Previous inspection reports by PennDer

APPENDIX C

PHOTOGRAPHS



KEHLEY RUN DAM NO. 6



1. Right half of crest. Right spillway weir in foreground.



2. Upstream face.

KEHLEY RUN DAM NO. 6



3. Upstream face near center of dam showing localized riprap failures and concrete paving.

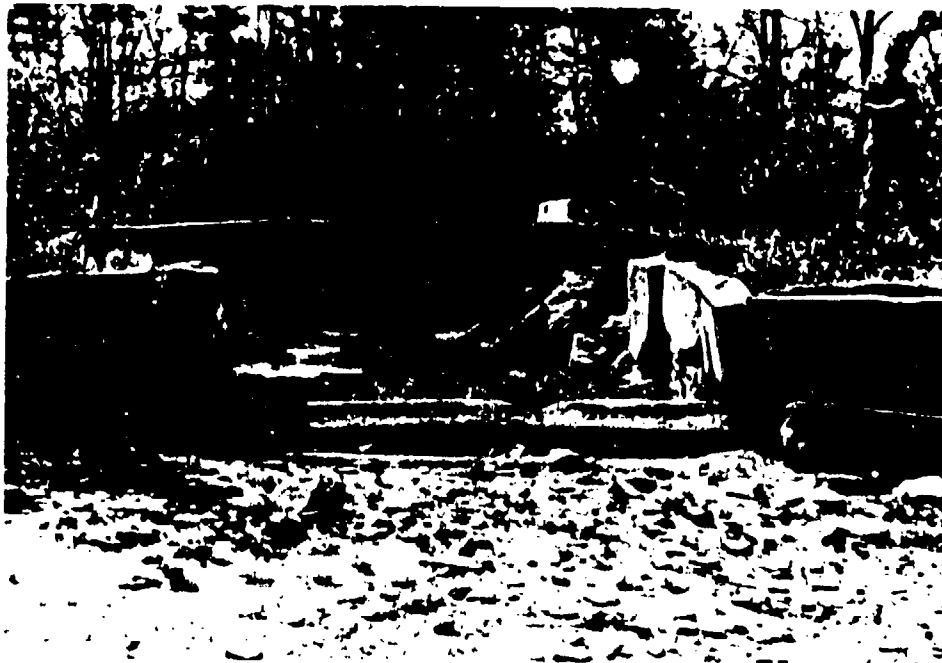


4. Two cast iron pipes which exit toe near the left spillway.

KEHLEY RUN DAM NO. 6



5. Downstream face and tailwater (3 Dec 80).



6. Left spillway.

KEHLEY RUN DAM NO. 6



7. Left spillway discharge channel and downstream face (3 Dec 80).



8. Control section of right spillway (3 Dec 80).

KERLEY RUN DAM NO. 6

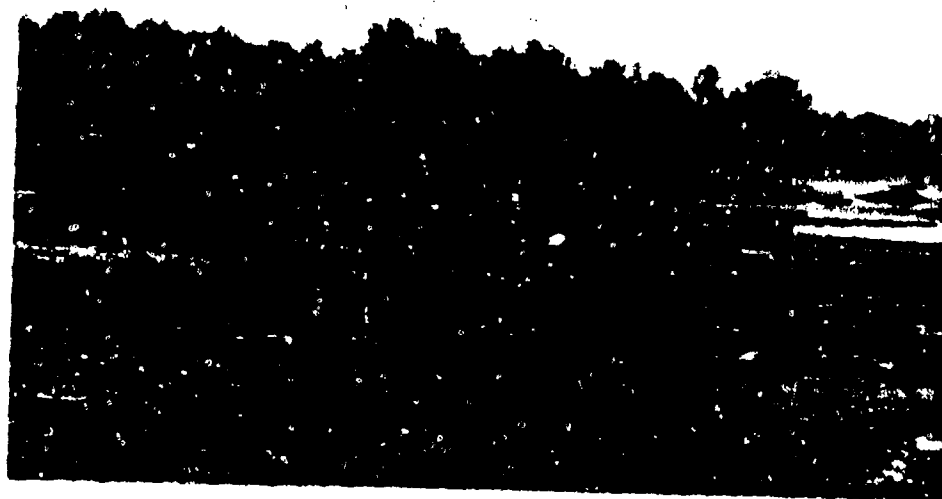


9. Right spillway weir and discharge channel (3 Dec 80).



10. Valve at discharge end of outlet works.

KEHLEY RUN DAM NO. 6



11. Dam and reservoir of Kehley Run Dam No. 5.
Spillway is at far left.



12. Downstream hazard (Town of Shenandoah).
Channel of Kehley Run at lower left (3 Dec 80).

APPENDIX D

HYDROLOGY AND HYDRAULICS

PREFACE

The modified HEC-1 program is capable of performing two basic types of hydrologic analyses: 1) the evaluation of the overtopping potential of the dam; and 2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. Briefly, the computational procedures typically used in the dam overtopping analysis are as follows:

- a. Development of an inflow hydrograph(s) to the reservoir.
- b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.
- c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide the peak discharge(s), time(s) of the peak discharge(s), and the maximum stage(s) of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequence resulting from an assumed structural failure (breach) of the dam is typically performed as shown below.

- a. Development of an inflow hydrograph(s) to the reservoir.
- b. Routing of the inflow hydrograph(s) through the reservoir.
- c. Development of a failure hydrograph(s) based on specified breach criteria and normal reservoir outflow.
- d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak and maximum water surface elevations of failure hydrographs for each location.

HYDROLOGY & HYDRAULIC ANALYSIS DATA BASE

NAME OF DAM: KEHLEY RUN DAM No. 6

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.4 INCHES/24 HOURS (1.)

SUSQUEHANNA RIVER BASIN

STATION	1	2	3
STATION DESCRIPTION	KEHLEY RUN DAM No. 6		
DRAINAGE AREA (SQUARE MILES)	0.30		
CUMULATIVE DRAINAGE AREA (SQUARE MILES)	0.30		
ADJUSTMENT OF PMF FOR (1) DRAINAGE AREA LOCATION (%) <u>ADJUSTED VALUES:</u> 6 Hours 12 Hours 24 Hours 48 Hours 72 Hours	101% 118 128 137 144 146		
SNYDER HYDROGRAPH PARAMETERS Zone (2) C_p (3) C_t (3) L^t (MILES) L_{ca} (MILES) (4) $t_p = C_t (L + L_{ca}) 0.3$ (HOURS)	13 0.50 1.85 1.36 0.51 1.66		
SPILLWAY DATA CREST LENGTH (FEET) FREEBOARD (FEET)	<u>LEFT:</u> 11.0 2.8 <u>RIGHT:</u> 26.0 2.8		

(1) HYDROMETEOROLOGICAL REPORT - 40, U. S. Army Corps of Engineers, 1965, AND
U.S. WEATHER BUREAU.

(2) Hydrologic zone defined by Corps of Engineers, Baltimore District, For
Determination of Snyder Coefficients (C_p and C_t).

(3) Snyder Coefficient

(4) L = Length of longest watercourse from dam to basin divide.

L_{ca} = Length of longest watercourse from dam to point opposite basin centroid.

SUBJECT DAM SAFETY ANALYSISCOMPUTATIONS KEHLEI' RUN DAM No. 6 SHEET 1 OF _____ SHEETSCOMPUTED BY JPB CHECKED BY _____ DATE 5-4-81DAM CLASSIFICATION:

SIZE OF DAM - SMALL
 HAZARD - HIGH
 REQUIRED SDF - 1/2 PMF TO FULL PMF

DAM STATISTICS:

HEIGHT OF DAM - 20.1 FEET
 STORAGE AT NORMAL POOL - 41 AC-FT
 STORAGE AT TOP OF DAM - 158 AC-FT
 DRAINAGE AREA ABOVE DAM SITE - 0.30 mi²

ELEVATIONS:

TOP OF DAM LOW POINT (FIELD) - 1677.8
 NORMAL POOL - 1675.0
 SPILLWAY CREST - 1675.0
 STREAM BED AT TOE - 1657.7

HYDROGRAPHIC PARAMETERS:

RIVER BASIN - SUSQUEHANNA RIVER BASIN
 ZONE - 13

SYNDER COEFFICIENTS:

$$C_p = 0.50$$

$$C_e = 1.85$$

MEASURED PARAMETERS: *

$$L = \text{LENGTH OF LONGEST WATERCOURSE} \quad L = 1.36 \text{ mi}$$

$$L_{CA} = \text{LENGTH OF LONGEST WATERCOURSE TO CENTROID OF THE BASIN} \quad L_{CA} = 0.51 \text{ mi}$$

* - FROM U.S.G.S. QUAD SHEET ENTITLED SHENANDOAH, PA.
 7 1/2 MINUTE SERIES, SCALE 1:24,000

SUBJECT DAM SAFETY ANALYSISCOMPUTATIONS KENNEY RUN DAM No. 6 SHEET 2 OF _____ SHEETSCOMPUTED BY JRB CHECKED BY _____ DATE 5-4-81

NOTE: ELEVATIONS ARE REFERENCED TO TOPOGRAPHIC DATA, POOL ELEVATION 1675. THIS WILL BE NORMAL POOL.

L_p = SYNDERS BASIN LAG TIME, HOURS

$$L_p = C_L (L A_c)^{0.3}$$

$$= 1.85 (1.36 \text{ mi} (0.51 \text{ mi}))^{0.3} = 1.66 \text{ HOURS}$$

RESERVOIR CAPACITY:

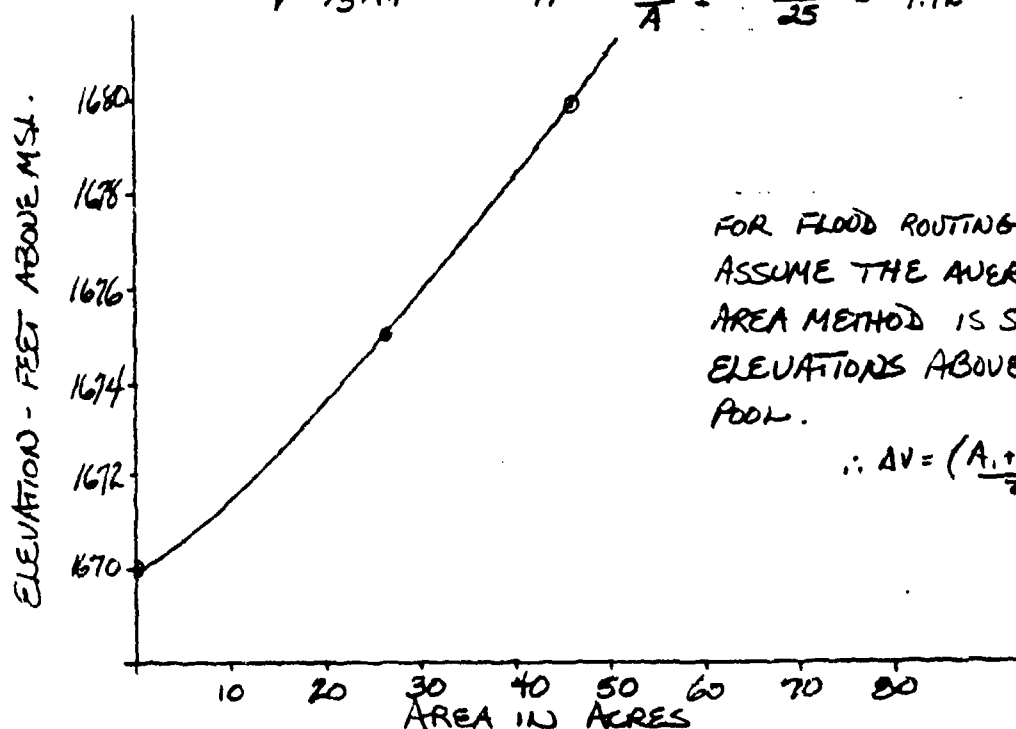
- SURFACE AREA AT SPILLWAY CREST - 25 ACRES
- SURFACE AREA AT ELEVATION 1680 - 45 ACRES

ASSUME CONICAL METHOD APPLIES TO FIND LOW POINT IN POOL, BELOW SPILLWAY CREST (EL. 1675.0)

VOLUME AT SPILLWAY CREST - 41 ACRE-Feet
(FROM POND DER FILES)

$$V = \frac{1}{3} A H$$

$$H = \frac{3V}{A} = \frac{3(41)}{25} = 4.92 \text{ Call it } 5'$$



FOR FLOOD ROUTING PURPOSES
ASSUME THE AVERAGE END
AREA METHOD IS SUITABLE TO
ELEVATIONS ABOVE STARTING
POOL.

$$\therefore \Delta V = \left(\frac{A_1 + A_2}{2} \right) \Delta H$$

SUBJECT DAM SAFETY ANALYSISCOMPUTATIONS KEHLEY RUN DAM NO. 6 SHEET 3 OF _____ SHEETSCOMPUTED BY JTB CHECKED BY _____ DATE 5-5-81ELEVATION - STORAGE TABLE:

ELEVATION (MSL)	AREA (ACRES)	ΔH (FT)	$\Delta V = \left(\frac{A_1 + A_2}{2} \right) \Delta H$ (AC-FT)	CUMULATIVE VOLUME (AC-FT)
1670	0	-	-	0
1675	25.0	-	41	41
1676	30.0	1.0	29.5	68.5
1677	34.0	1.0	32.0	100.5
1677.8	37.5	0.8	57.2	157.7
1678	38.0	0.2	7.5	165.2
1679	42.5	1.0	40.3	205.5
1680	45.0	1.0	43.8	249.3

NOTE - DRAINAGE AREA ABOVE DAM IS 0.27 mi²

ELEVATION (MSL)	STORAGE (AC-FT)
1670	0
1675	41
1676	68
1677	100
1677.8 (TOD)	158
1678	165
1679	205
1680	249

* (TOD) - TOP OF DAM

SUBJECT DAM SAFETY ANALYSISCOMPUTATIONS KEHLEY RUN DAM No. 6 SHEET 4 OF _____ SHEETSCOMPUTED BY JPB CHECKED BY _____ DATE 5-5-81PMF CALCULATIONS:

- APPROXIMATE RAINFALL INDEX = 22.4
(CORRESPONDS TO A DURATION OF 24 HOURS AND A DRAINAGE AREA OF 200 mi²)
- SUSQUEHANNA RIVER BASIN
- DEPTH-AREA-DURATION HYDROMET 40 VALUES
GEOGRAPHIC AREA ADJUSTMENT MADE BY HYDROMET 40
FIGURE 1 IS 101 %
- ASSUME VALUES CORRESPONDING TO A 10 mi² AREA MAY BE USED ON THIS 0.30 mi²

<u>DURATION (HRS)</u>	<u>PERCENT OF INDEX RAINFALL</u>	
6	117	118
12	127	128
24	136	137
48	143	144
72	145	146

NOTE: HOP BROOK FACTOR IS INTERNALLY COMPUTED BY THE HELI PROGRAM. FOR A DRAINAGE AREA LESS THAN 10 SQUARE MILES, THE ADJUSTMENT FACTOR = 0.80. THIS ADJUSTMENT IS FOR BASIN SHAPE AND THE LESS LIKLIHOOD OF A SEVERE STORM CENTERING OVER A SMALL BASIN.

SDF: BASED ON THE SMALL STORAGE AND SMALL HEIGHT, THE SDF SELECTED FOR A HIGH HAZARD WOULD NORMALLY BE 1/2 THE PMF. HOWEVER, BASED ON THE DOWNSTREAM DAMS AND DEVELOPMENT THE SELECTED SDF IS THE FULL PMF.

THEREFORE, SDF = FULL PMF.

SUBJECT DAM SAFETY ANALYSISCOMPUTATIONS KEHLEY RUN DAM NO. 6 SHEET 5 OF _____ SHEETSCOMPUTED BY JPB CHECKED BY _____ DATE 5-5-81EMERGENCY SPILLWAY CAPACITY:

THIS FACILITY HAS 2 SPILLWAYS, ONE LOCATED AT EACH END OF THE DAM. BOTH SPILLWAYS FLOW INTO KEHLEY RUN NO. 5 IMMEDIATELY DOWNSTREAM OF KEHLEY RUN NO. 6.

SPILLWAY DATA:LEFT SPILLWAY

TYPE - RECTANGULAR BROAD-CRESTED WEIR
 LENGTH - 11 FEET
 CREST ELEVATION - 1675.0
 C VALUE - 2.85
 FREEBOARD - 2.8 FEET
 LOW POINT TOP OF DAM - 1677.8

RIGHT SPILLWAY

TYPE - TRAPEZOIDAL SHAPED BROAD-CRESTED WEIR
 LENGTH - 26 FEET
 CREST ELEVATION - 1675.0
 C VALUE - 2.85
 FREEBOARD - 2.8 FEET
 LOW POINT TOP OF DAM - 1677.8
 SIDE SLOPES 1 ON 1

LEFT SPILLWAY CALCULATIONS:

$$Q = CLH^{3/2}$$

$$C = 2.85, L = 11 \text{ ft.}$$

POOL ELEVATION (MSL)	H (ft)	Q (CFS)
1675	0	0
1676	1.0	31
1677	2.0	88.7
1677.8	2.8	146.9
1678	3.0	162.9
1679	4.0	250.8
1680	5.0	350.5

SUBJECT

DAM SAFETY ANALYSIS

COMPUTATIONS

KEHLEY RUN DAM NO. 6

SHEET

6

OF

SHEETS

COMPUTED BY

JPB

CHECKED BY

DATE

5-5-81

RIGHT SPILLWAY CALCULATIONS:

RESERVOIR ELEVATION (MSL)	L ₁ (ft)	L ₂ (ft)	INCREMENTAL HEAD, H _i (ft)	INCREMENTAL FLOW AREA, A _i (ft ²)	TOTAL FLOW AREA, A _T (ft ²)	WEIGHTED HEAD, H _W (ft)	Q (cfs)
1675	26.0	-	-	-	-	-	0
1676	28.0	26.0	1.0	27.0	27.0	0.94	70.1
1677	30.0	28.0	1.0	29.0	56.0	1.86	187.9
1677.8 (TUD)	31.6	30.0	0.8	24.6	80.6	2.55	321.7
1678	32.0	31.6	0.2	6.4	87.0	2.72	332.4
1679	34.0	32.0	1.0	33.0	120.0	3.53	491.5
1680	36.0	34.0	1.0	35.0	155.0	4.31	663.6

$$① A_i = H_i [(L_1 + L_2)/2]$$

$$\text{recall } L = 26 \text{ FEET}$$

$$C = 2.85$$

$$② H_W = A_T / L_1$$

$$③ Q = CL H_W^{3/2}$$

EMBANKMENT RATING TABLE:

THIS ANALYSIS ASSUMES THAT THE EMBANKMENT BEHAVES AS A BROAD-CRESTED WEIR IF OVERTOPPING OCCURS.

THIS DISCHARGE CAN BE ESTIMATED BY:

$$Q = CL H_W^{3/2}$$

WHERE:

Q = DISCHARGE OVER EMBANKMENT, IN CFS

L₁ = LENGTH OF EMBANKMENT, IN CFS

H_W = WEIGHTED HEAD, IN FEET, AVERAGE FLOW AREA

C = COEFFICIENT DISCHARGE

C = 2.85 FROM VARNELL & NAGLER FOR BROAD-CRESTED WEIR

SUBJECT DAM SAFETY ANALYSISCOMPUTATIONS KEHLEY RUN DAM NO. 6 SHEET 7 OF _____ SHEETSCOMPUTED BY JMB CHECKED BY _____ DATE 5-5-81LENGTH OF EMBANKMENT INUNDATED
VS. RESERVOIR ELEVATION:

RESERVOIR ELEVATION (MSL)	EMBANKMENT LENGTH (Ft)
1677.8	0
1678.0	490
1679.0	1363*
1680.0	1363*

* MAXIMUM LENGTH OF EMBANKMENT LESS SPILLWAY WIDTH
AND OVBANK AREA.EMBANKMENT RATING TABLE:

RESERVOIR ELEVATION (MSL)	L ₁ (Ft)	L ₂ (Ft)	INCREMENTAL HEAD, H _i (Ft)	① INCREMENTAL FLOW AREA, A _i (F ²)	TOTAL FLOW AREA, A _T (F ²)	② WEIGHTED HEAD, H _W (Ft)	③ Q (CFS)
1677.8	0	-	-	-	-	-	0
1678.0	490	0	0.2	49	49	0.10	44.1
1679.0	1363	490	1.0	926.5	975.5	0.72	2373.2
1680.0	1363	1363	1.0	1363.0	2338.5	1.72	8762.2

① $A_i = H_i [(L_1 + L_2)/2]$

② $H_W = A_T / L_1$

③ $Q = C L_1 H_W^{3/2}$

RECALL $C = 2.85$

SUBJECT

DAM SAFETY ANALYSIS

COMPUTATIONS

KEHLEY RUN DAM NO. 6

SHEET

8

OF

SHEETS

COMPUTED BY

JPB

CHECKED BY

DATE

5-5-87

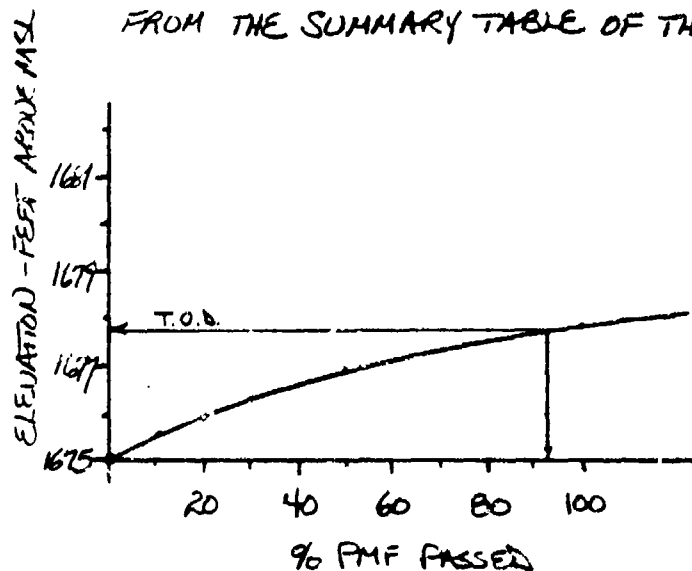
TOTAL FACILITY RATING CURVE :

RESERVOIR ELEVATION (MSL)	LEFT SPILLWAY (CFS)	Q SPILLWAY RIGHT SPILLWAY (CFS)	Q EMBANKMENT (CFS)	Q TOTAL (CFS)
1675	0	0	0	0
1676	31	70	0	101
1677	89	188	0	277
1679.8 (T.O.D.)	147	302	0	449
1678.0	163	332	44	539
1679.0	250	492	2373	3115
1680.0	350	663	8762	9775

THE ABOVE VALUES WILL BE INPUT ON Y4 & Y5 CARDS.

RESULTS OF THE OVERTOPPING ANALYSIS :

FROM PAGE D-16, THE FOLLOWING CURVE CAN BE DRAWN FROM THE SUMMARY TABLE OF THIS APPENDIX.



TOP OF DAM ELEVATION
AT 1677.8

KEHLEY RUN NO. 6 DAM
CAN PASS 92% OF THE PMF
PRIOR TO OVERTOPPING THE
EMBANKMENT.

THIS FACILITY CAN CONTROL 92% OF THE PMF. AT THE SDF (FULL) THE DAM IS OVERTOPPED TO A MAXIMUM HEIGHT OF 0.11 FEET

SUBJECT DAM SAFETY ANALYSISCOMPUTATIONS KEHLEY RUN DAM NO. 6 SHEET 9 OF _____ SHEETSCOMPUTED BY JPR CHECKED BY _____ DATE 5-6-81

FOR A TOTAL DURATION OF 2.0 HOURS. SINCE THIS FACILITY CAN PASS $\frac{1}{2}$ PMF WITHOUT OVERTOPPING BUT CANNOT PASS THE SDF (FULL PMF), THE SPILLWAY IS RATED AS INADEQUATE. NO BREACH ANALYSIS IS REQUIRED.

OUTLET WORKS:

KEHLEY RUN DAM NO. 6 HAS A 12 INCH CAST IRON PIPE THROUGH THE EMBANKMENT INTO KEHLEY RUN DAM NO. 5. THE UPSTREAM INVERT COULD NOT BE LOCATED. THE REVIEW INSPECTION IN MAY 1961, FOUND THE DOWNSTREAM INVERT APPROXIMATELY 5 FEET BELOW NORMAL POOL IN KEHLEY RUN DAM NO. 5. THE DOWNSTREAM INVERT WAS ASSUMED TO BE AT ELEVATION 1657.0.

MAXIMUM POOL AT KEHLEY RUN DAM NO. 6 - 1677.8
TAILWATER IN KEHLEY RUN DAM NO. 5 - 1662.0

12 INCH SUBMERGED, THEREFORE USE OUTLET CONTROL.

DIFFERENTIAL HEAD - $15.8 \text{ m} = H$

OUTLET WORKS DISCHARGE AT MAXIMUM POOL - *

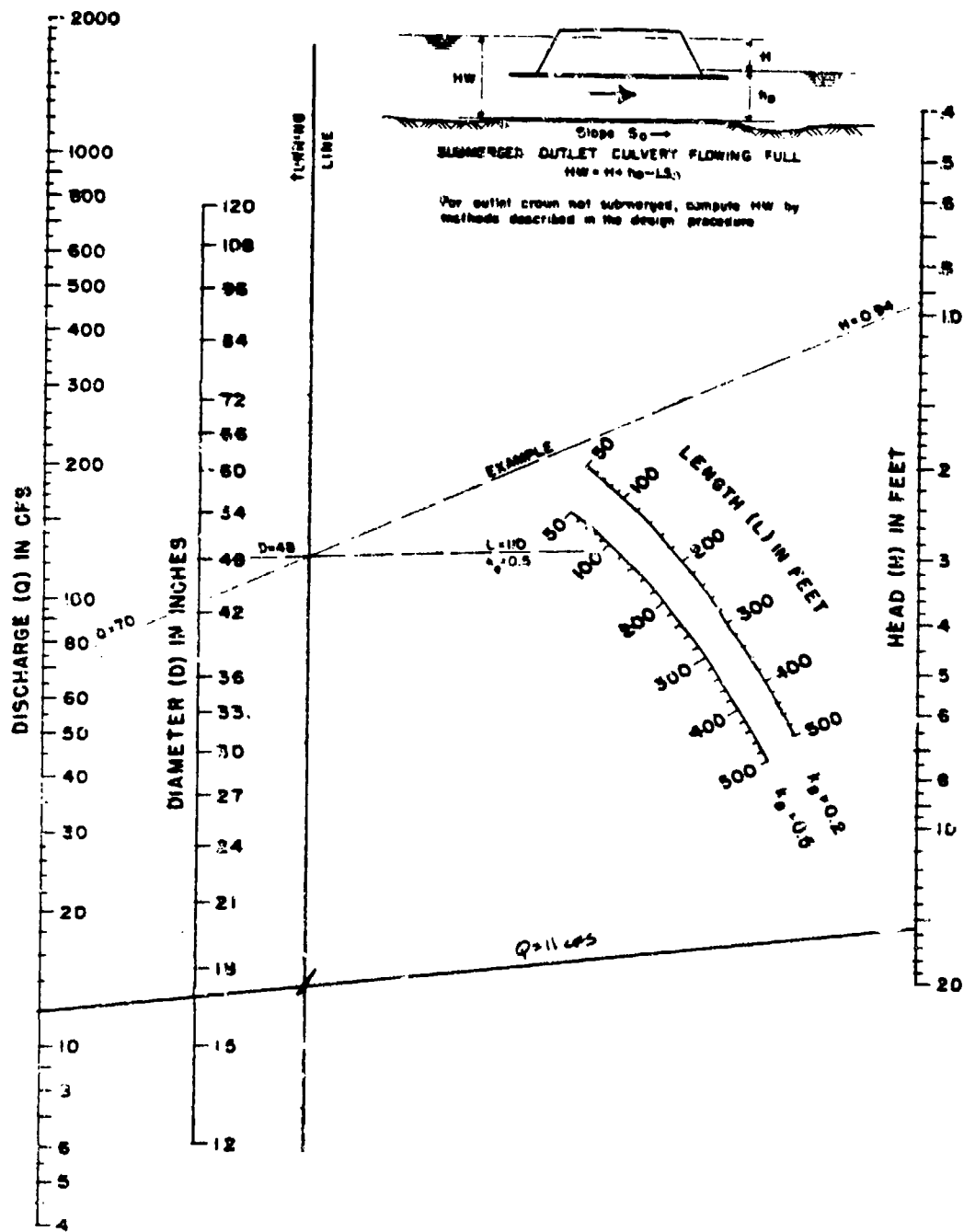
ASSUME: $K_e = 0.5$ MATERIAL -
 $L \approx 100 \text{ FEET}$
SLOPE $\approx 0.005 \text{ ft/ft}$

$H = 15.8 \text{ FEET}$ $Q = 11 \text{ CFS}$

ASSUME $n = 0.012$ FOR CAST IRON PIPE, THEREFORE CHART 9 WOULD BE APPLICABLE.

SEE CHART IN THIS APPENDIX, TAKEN FROM HYDRAULIC CHARTS FOR SELECTION OF HIGHWAY CULVERTS, U.S. DEPT. COMMERCE, 170

CHART 9



HEAD FOR
 CONCRETE PIPE CULVERTS
 FLOWING FULL
 $n = 0.012$

BUREAU OF PUBLIC ROADS JAN. 1963

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 01 APR 80

1	A1	KEHLEY RUN NO. 6 DAM		DER NO. 70-54-20						
2	A2	DAM SAFETY INSPECTION PROGRAM		5-5-81						
3	A3	OVERTOPPING ANALYSIS		*** PRELIMINARY ***						
4	B	144	0	20	0	0	0	0	0	0
5	B1	5	0	0	0	0	0	0	0	0
6	J	1	5	1						
7	J1	0.10	0.20	0.30	0.50	1.00				
8	K	0	1	0	0	0	1	0	0	0
9	K1	RUNOFF FROM DRAINAGE AREA ABOVE KEHLEY RUN NO. 6 DAM								
10	M	1	1	0.30	0	0.30	0	0	1	0
11	P	0	22.4	118	128	137	144	146		
12	T	0	0	0	0	0	0	1.0	0.05	0
13	W	1.66	0.50							
14	X	-1.5	-0.05	2						
15	K	1	1	0	0	0	0	1	0	0
16	K1	ROUTING ZPH'S THRU KEHLEY RUN NO. 6 DAM AND SPILLWAY								
17	Y	0	0	0	1	0	0	0	0	0
18	Y1	1	0	0	0	0	-1675.0	-1	0	0
19	Y4	1675	1676	1677	1677.8	1678	1679	1680		
20	Y5	0	101	277	449	539	3115	9775		
21	SS	0	41	68	100	158	165	205	249	
22	SE	1670	1675	1676	1677	1677.8	1678	1679	1680	
23	SS1675.0									
24	SD1677.8									
25	K	99								

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1
 ROUTE HYDROGRAPH TO 1
 END OF NETWORK

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 01 APR 80

RUN DATE# 81/05/05.
 TIME# 12.27.14.

KEHLEY RUN NO. 6 DAM DER NO. 70-54-20
 DAM SAFETY INSPECTION PROGRAM 5-5-81
 OVERTOPPING ANALYSIS *** PRELIMINARY ***

JOB SPECIFICATION									
NO	NHR	NMIN	IDAY	IHR	IMIN	METRIC	IPLT	IPRT	NSTAN
144	0	20	0	0	0	0	0	0	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED

NPLAN= 1 NRTIO= 5 LRTIO= 1
 RTIOS= .10 .20 .30 .50 1.00

KEHLEY RUN DAM No. 6

OVERTOPPING ANALYSIS

page 1/3

D-14

SUB-AREA RUNOFF COMPUTATION

RUNOFF FROM DRAINAGE AREA ABOVE KEHLEY RUN NO. 6 DAM

ISTAQ 1 ICOMP 0 IECON 0 ITAPE 0 JPLT 0 JPRT 0 INAME 1 ISTAGE 0 IALTO 0

HYDROGRAPH DATA

IHYDG 1 IUNG 1 TAREA .30 SNAP 0.00 TRSDA .30 TRSPC 0.00 RATIO 0.000 ISNOW 0 ISAME 1 LOCAL 0

PRECIP DATA

SPFE 0.00 PMS 22.40 R6 118.00 R12 128.00 R24 137.00 R48 144.00 R72 146.00 R96 0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT 0 STRKR 0.00 DLTGR 0.00 RTIOL 1.00 ERAIN 0.00 STRKS 0.00 RTIOK 1.00 STRTL 1.00 CNSTL .05 ALSMX 0.00 RTIMP 0.00

UNIT HYDROGRAPH DATA

TP= 1.66 CP= .50 NTA= 0

RECESSION DATA

STRTO= -1.50 GRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 5.58 AND R= 6.53 INTERVALS

UNIT HYDROGRAPH 38 END-OF-PERIOD ORDINATES, LAG= 1.68 HOURS, CP= .50 VOL= 1.00

4.	16.	33.	48.	5.	58.	52.	44.	38.	33.
23.	24.	21.	18.	15.	13.	11.	10.	8.	7.
6.	5.	4.	4.	3.	3.	2.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	0.		

END-OF-PERIOD FLOW

HYDROGRAPH ROUTING

ROUTING ZPMF'S THRU KEHLEY RUN NO. 6 DAM AND SPILLWAY

ISTAQ 1 ICOMP 1 IECON 0 ITAPE 0 JPLT 0 JPRT 0 INAME 1 ISTAGE 0 IALTO 0

ROUTING DATA

GLOSS 0.0 CLOSS 0.000 AVG 0.00 IRES 1 ISAME 1 IOPT 0 IPMP 0 LSTR 0

NSTPS 1 NSTDL 0 LAG 0 AMSKK 0.000 X 0.000 TSK 0.000 STORA -1675. ISPRAT -1

STAGE	1675.00	1676.00	1677.00	1677.80	1678.00	1679.00	1680.00
FLOW	0.00	101.00	277.00	449.00	539.00	3115.00	9775.00
CAPACITY=	0.	41.	68.	100.	158.	165.	205.
ELEVATION=	1670.	1675.	1676.	1677.	1678.	1678.	1679.

CREL 1675.0 SPWID 0.0 COOW 0.0 EXPW 0.0 ELEV 0.0 COOL 0.0 CAREA 0.0 EXPL 0.0

DAM DATA

TOPEL 1677.8 COOD 0.0 EXPD 0.0 DAMWID 0.

STATION 1. PLAN 1. RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

KEHLEY RUN DAM No. 6

OVERTOPPING ANALYSIS

1 *****

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS				
				RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 .50	RATIO 5 1.00
HYDROGRAPH AT	1	.30	1	77.	153.	230.	363.	766.
	(	.78)	(	2.17)(	4.34)(	6.51)(	10.85)(	21.70)(
ROUTED TO	1	.30	1	49.	98.	159.	275.	500.
	(	.78)	(	1.39)(	2.77)(	4.50)(	7.78)(	14.16)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

ELEVATION STORAGE OUTFLOW	INITIAL VALUE 1675.00 41. 0.	SPILLWAY CREST 1675.00 41. 0.	TOP OF DAM 1677.60 158. 449.
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RATIO OF PWF	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1675.49	0.00	54.	49.	0.00	43.33	0.00
.20	1675.97	0.00	67.	98.	0.00	43.33	0.00
.30	1676.33	0.00	79.	159.	0.00	43.33	0.00
.50	1676.99	0.00	100.	275.	0.00	43.00	0.00
1.00	1677.99	.19	165.	533.	2.00	43.33	0.00

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 01 APR 80

C)

KENLEY ROAD DAM No. 6

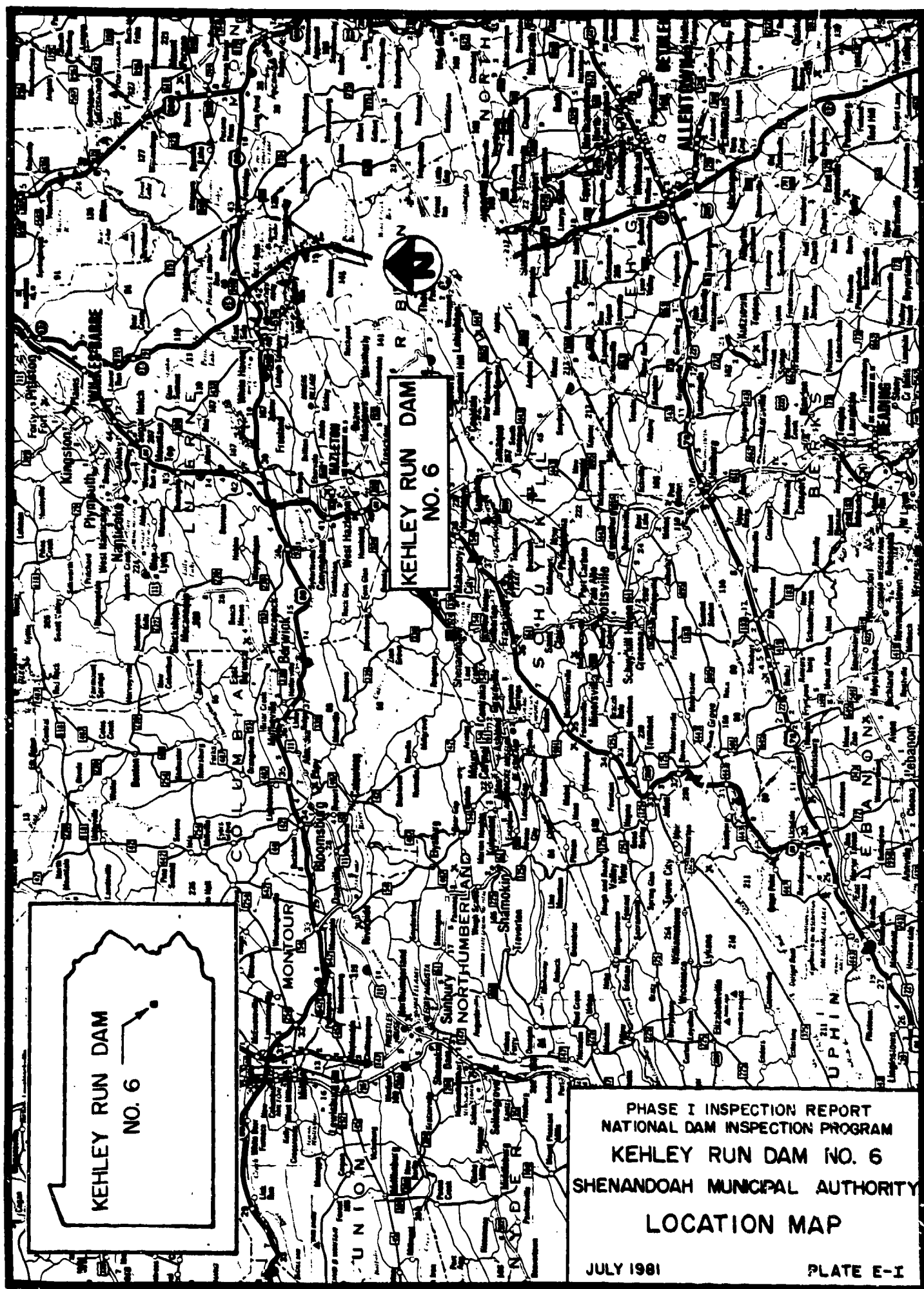
OVERTOPPING ANALYSIS

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APPENDIX E

PLATES



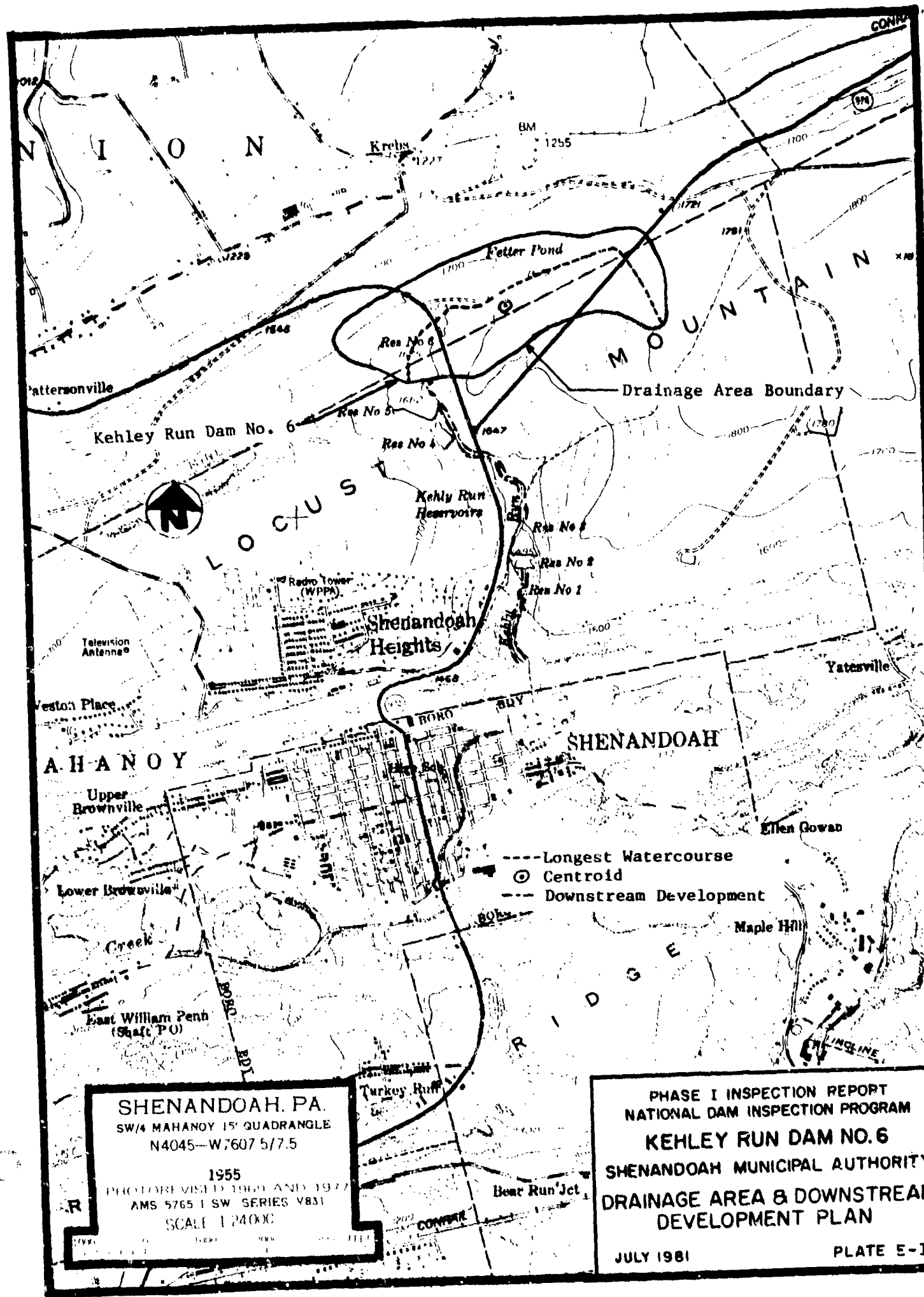
KEHLEY RUN DAM
NO. 6

KEHLEY RUN DAM
NO. 6

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
KEHLEY RUN DAM NO. 6
SHENANDOAH MUNICIPAL AUTHORITY
LOCATION MAP

JULY 1981

PLATE E-I



APPENDIX F

GEOLOGY

GENERAL GEOLOGY

Bedrock at Kehley Run Dam #6 is the Schuylkill member of the Pottsville Formation, which is conglomerate, conglomeratic sandstone and sandstone with minor shale interbeds. It is generally a hard resistant rock unit. Stratigraphically above the Pottsville, the Llewellyn Formation comprises the core of the synclinal fold. It is sandstone, conglomeratic sandstone and shale with numerous mineable coals. The Lykens Valley No. 3 coal is near the base of the Schuylkill Member and beneath that is the Lykens Valley No. 2 coal neither of which appear to have been mined beneath the reservoir.

According to PennDER, Bureau of Topographic and Geologic Survey, areas adjacent to the reservoir on the northeast and southwest have been strip mined. No signs of strip mining were found close enough to the dam or reservoir to be considered a potential hazard.

LEGEND

(Bedrock)

- P1 LLEWELLYN FORMATION - Gray, fine- to coarse-grained sandstone, siltstone, shale, conglomerate, and numerous anthracite coals in repetitive sequences.
- Rp POTTSVILLE GROUP - Gray conglomerate, fine-to coarse-grained sandstone, and siltstone and shale containing minable anthracite coals. Includes three formations. In descending order: Sharp Mountain--conglomerate and conglomeratic sandstone; Schuylkill--sandstone and conglomeratic sandstone; Tumbling Run--conglomeratic sandstone and sandstone.
- Mmc MAUCH CHUNK FORMATION - Grayish-red shale, siltstone, sandstone, and some conglomerate; some local nonred zones. Includes Loyalhanna Member--crossbedded, sandy limestone at base of south-central and southwestern Pennsylvania; also includes Greenbrier Limestone Member and Wynne Gap and Deer Valley Limestones, which are tongues of the Greenbrier. Along Allegheny Front from Blair County to Sullivan County, Loyalhanna Member is greenish-gray, calcareous, crossbedded sandstone.

